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AN ANISIAN WETTERSTEIN LIMESTONE REEF IN NORTH HUNGARY

G. SCHOLZ

SUMMARY

In the vicinity of Aggtelek and Jósvafő in North Hungary there is a fossil reef formation with an extension of several km² belonging to the Anisian member of the Wetterstein sedimentary sequence. Surrounded by Dasycladacea-bearing sediments, the reef complex can be split up into three main facies: *1.* a central reef with colonial corals, hydrozoans and Calcispongia; *2.* a reef slope under heavy wave action with a paleobiocoenosis consisting of brachiopods, molluscs and echinoderms; *3.* a more quiet-water reef slope with echinoderms and molluscs. The growth of the 500- to 600-m-thick reef complex began in early Pelsonian time and stopped before the deposition of the Upper Illyrian *Diplopora annulatissima* Horizon. In the Late Illyrian the entire reef was covered by dasycladaceous sediments. The paper is terminated by the descriptions of a new calcareous sponge (*Colospongia catenulata macrocatenulata* n. ssp.), a new hydrozoan (*Axopora aggtelekensis* n. sp.) and a new coral (*Protoheterastrea pseudocolumellaris* n. sp.).

INTRODUCTION

The area under consideration is situated between Aggtelek and Jósvafő villages on the southern margin of the southern limestone zone of the Gemerides *(Fig. 1)*. Constituted by shales, marls and limestone laminae, the Campilian beds are overlain by the Lower Anisian (Hydaspian) Horizon which is represented by Gutenstein limestones and dolomites. The Anisian age of the overlying Wetterstein limestone and dolomite sequence was proved by Z. SCHRÉTER [1935, p. 148] and K. BALOGH [1961, p. 370; 1964, p. 362 and Table 4] with brachiopods and Dasycladaceae belonging to the Decurtata Horizon. According to these authors, the Wetterstein facies still continues in the Ladinian Stage, a statement evidenced by finds of *Daonella lommeli* WISSMANN and *diplopora annulata* SCHAFHÄUTL from outside the area under consideration.

In the existing publications the "lagoonal" or "reef" facies with Dasycladaceae, calcareous sponges, corals, brachiopods and crinoids of the Wetterstein Formation are dealt with at large [K. BALOGH 1948, p. 920; 1950, p. 237] without their being discriminated on map. The present writer's investigations have been aimed at filling this gap and at specifying the environmental conditions by a more accurate description and delimitation of the particular facies.

I. THE FACIES OF THE WETTERSTEIN FORMATION

Overlying the Gutenstein Beds, the Middle to Upper Anisian Wetterstein sequence includes the following heteropical facies:

1. Dasycladaceous Limestones Surrounding the Reef

Taking the reverse of Walther's Faziesregel, the writer supposes the reef formation to be discussed later to have formed a body intertonguing with the dasycladaceous limestone facies which had originally surrounded it *(Fig. 1 and 3)*. Because of the overall tilting of the sequence, however, gradually younger members of the essentially synchronous facies are met with as one proceeds from the NE to the SW *(Fig. 2)*. Accordingly, older and younger beds of even the dasycladaceous limestones themselves can be observed on the surface.

(a) The dasycladaceous limestones of the deeper level are usually in immediate contact with the grey bituminous dolomites of the Gutenstein Formation. Along the Jósvafő road and the Csurkólápa, these dolomites grade literally into the dasycladaceous limestones.

At both localities it can be readily observed that the Gutenstein dolomites turn gradually white, thus grading into the Wetterstein dolomites, well-stratified, of saccharoidal texture. Above these follow red-mottled, dolomitic limestones overlain by 35 to 40 cm of red, compact, unfossiliferous limestone which is followed, on its turn, by light grey dasycladaceous limestones containing the following Pelsonian fossils *(Fig. 1)*:

DASYCLADALES:

Physoporella dissita (GÜMBEL) PIA (Localities 1, 4, and 33; *Plate II, Fig. 1*)
Physoporella pauciforata pauciforata (PIA) BYSTRICKÝ (Localities 2, 4, 33; *Plate II, Fig. 2*)
Diplopora hexaster PIA (Locality 2; *Plate II, Figs. 3—4*)
Oligoporella pilosa pilosa PIA (Localities 2, 4, 33; *Plate II, Fig. 5*)

FORAMINIFERA:

Ammobaculites radstadtensis KRISTAN-TOLLMANN (Locality 1 of the *Fig. 1*)
Meandrospira dinarica KOCH.-DEV. et PANTIĆ (Localities 1, 4, 33; *Plate I, Figs. 1, 3*)
Meandrospira insolita (HO) (Locality 1; *Plate I, Fig. 2*)

Endothyranella cf. *pentacamerata* SALAJ. (Locality 1; *Plate I, Fig. 6*)
Calcitornella sp. (in KOEHN-ZANINETTI) (Locality 1; *Plate I, Fig. 5*)

BRYOZOA (Locality 1)

BIVALVIA (Locality 1)

GASTROPODA (Locality 1)

The dasycladaceous limestones are locally *(Fig. 1)* interbedded with onkoidal limestone banks suggestive of local turbidities of varying intensity. The onkoids vary between a few mm and a couple of cm in diametre. Their concentric, interwoven blue-algal filaments have surrounded foraminiferal tests and rock and mollusc fragments. Their size and shape have been controlled, beside the shape and size of the object overgrown, by the duration of their growth. The onkoids of the deeper-seated onkoidal banks are small and unsorted (disordered), while the country rock is of somewhat coarser grain size *(Plate III, Fig. 2)*. The onkoids of the higher-seated banks are larger and display a bedded pattern. Those of each particular onkoidal band are of roughly the same size, though there are considerable differences in this respect between different bands *(Plate III, Fig. 1)*. The groundmass of the "bedded" onkoids is of relatively finer grain size than that of the "sterile" bands between the onkoidal bands.

The onkoidal limestone is undoubtedly the heteropical facies of the deeper-seated dasycladaceous limestone: a fact evidenced by the microfossils of Localities 5, 7 and 32 corresponding to those of the former. Let us quote the fossils:

FORAMINIFERA:

Meandrospira dinarica KOCH.-DEV. et PANTIĆ
Meandrospira insolita (HO).
Endothyranella cf. *pentacamerata* SALAJ
Calcitornella sp. (in KOEHN-ZANINETTI).

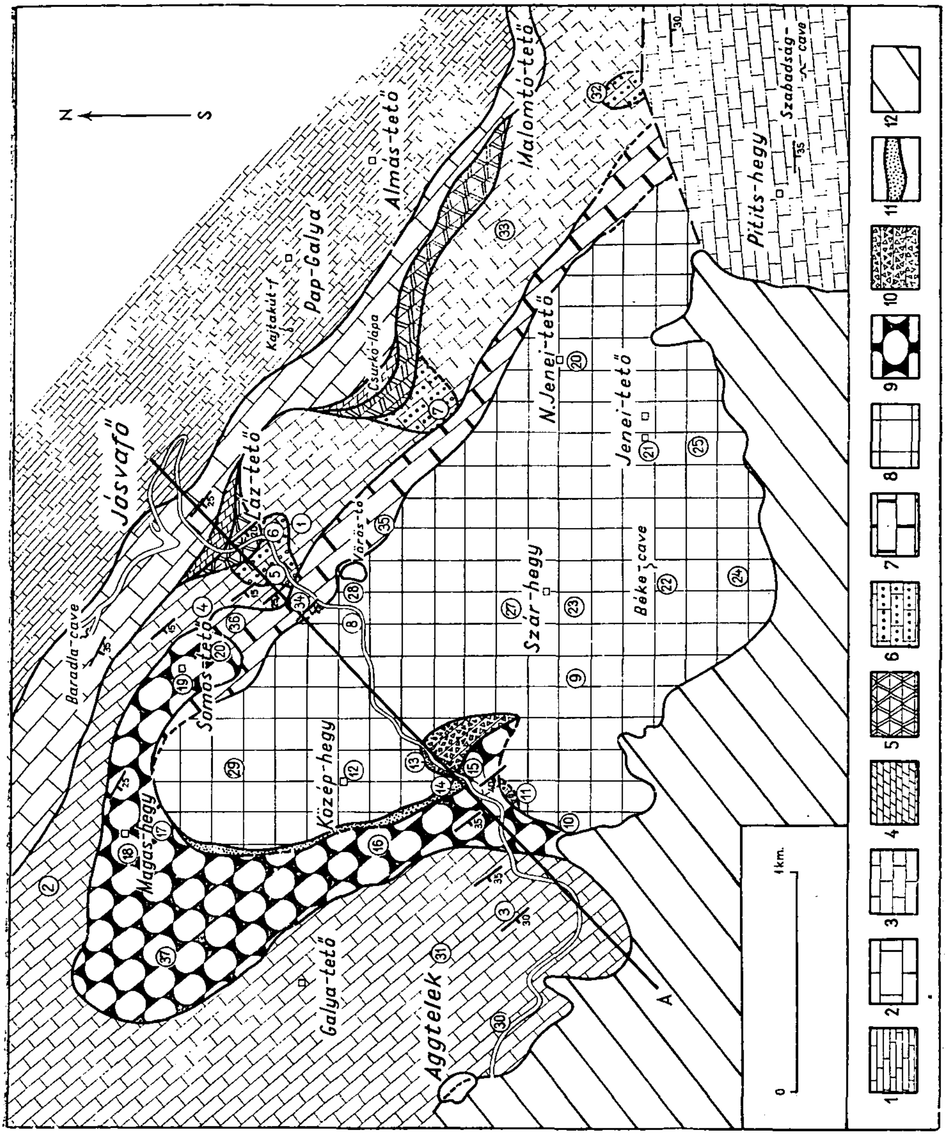

Fig. 1. Facies map of the Trias in the vicinity of Aggtelek
1. Campilian marl and limestone. *2.* Gutenstein limestone and dolomite. *3.* Dasycladaceous Wetterstein limestone. *4.* Wetterstein dolomites of saccharoidal texture. *5.* Calcareous dolomite, dolomitic limestone. *6.* Onkoidal Wetterstein limestone. *7.* Bioclastic Wetterstein limestone with echinoderms and molluscs. *8.* Unstratified limestone. *9.* Wetterstein limestone, thick-bedded, bioclastic with brachiopods and echinoderms. *10.* Red-cemented intraformational breccia. *11.* Wetterstein limestone with crinoid fragments. *12.* Pannonian gravel and sand. *13.* Profile line of Textfig. 2. *14.* Sampling points.

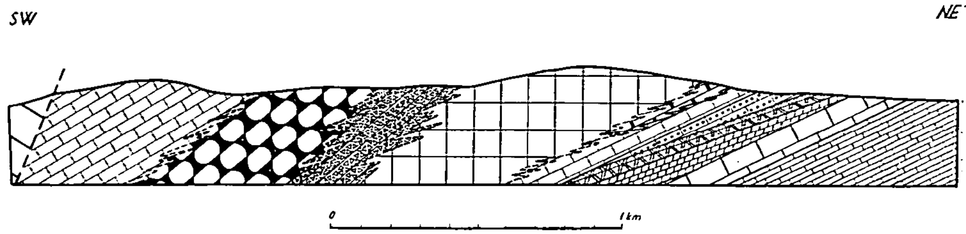

Fig. 2. Geological section of the investigated area. For explanations, see Fig. 1.

(b) Lying on the SW side of the reef complex, *the higher horizon of the dasycladaceous facies* (Localities 3, 30 and 31) has yielded the following fossils:

DASYCLADALES:
Physoporella dissita (GÜMBEL) PIA
Physoporella sp.

FORAMINIFERA:
Ammobaculites radstadtensis KRISTAN-TOLLMANN
Ammobaculites wirtzi KOEHN-ZANINETTI *(Plate I, Fig. 8)*
Trochammina almtalensis KOEHN-ZANINETTI *(Plate I, Fig. 7)*
Neoendothyra reicheli REITLINGER *(Plate I, Fig. 4)*
Earlandinita elongata SALAJ
Earlandinita oberhauseri SALAJ
Duostomina sp.

2. Facies of the Reef Complex

Within the reef body enclosed in the dasycladaceous limestones three main facies can be distinguished: *(a)* back-reef, *(b)* central reef, *(c)* fore-reef sediments *(Fig. 3)*. These are characterized by the following:

(a) Situated on the NE margin of the complex, the *back-reef* can be traced in 150 to 200 m width on the present-day surface. It consists of bioclastic limestones, rich crinoid and echinoid fragments, whose sorting is dependent on the turbidity of the environment of deposition. Nevertheless, the water cannot have been too agitated, as the skeletal elements, otherwise slightly rounded, are occasionally embedded without isolating from the other. Of the crinoids the ossicles of *Entrochus silesiacus* BEYRICH as well as *Encrinus* and *Dadocrinus* are recognizable (Localities 34, 35 and 36). Most of the echinoid spines are "piquants", while thin-spined forms, suggestive of a quiet-water environment occur just sporadically. Beside the above, a few fragments of larger *Naticopsis* have been observed to pattern the composition of the fauna.

The echinoderm-and-mollusc facies of the back-reef is replaced somewhere around the Somos-tető by brachiopodal limestones. Although undoubtedly older than the otherwise totally similar fore-reef facies, the brachiopodal limestones appear to be connected with this through the western and southwestern neighbourhood of the hill Magos-hegy. Therefore the description of the back-reef will be given together with that of the fore-reef.

(b) Striking NW-SE, the *central reef* exposed in a width greater than 1 km along the road is constituted by unstratified or thick-bedded limestones of somewhat darker shade. Characteristic fossils of these are calcareous sponges, colonial corals and hydrozoans which, however, do not belong to the most frequent because of having been reworked and diagenetically altered. The voids and cavities of the

original reef skeleton are filled up by fibrous calcite. Geopetal cavity-filling can be observed to be accompanied by re-sedimentation phenomena.

In part of the central reef, more massive, colonial corals (*Pinacophyllum* cf. *parallelum* FRECH, *"Thecosmilia,, subdichotoma* MÜNSTER and other representatives of *"Thecosmilia"*) are predominant (Localities 9, 10 and 11; *Plate IV, Fig. 2 and 3*). With their massive, straight polyparia, these seem to have acted as brakers protecting the more loosely packed colonies, composed of ramose and more gracious forms, of the biocoenosis of the innermost parts of the reef complex (Locality 8, *Plate IV, Fig. 1*). Although the systematic determination of these more gracious corals often happens to be impossible to carry out because of their recrystallized internal structure, it appears that among these too, again the representatives of *"Thecosmilia"* shared predominance with *Protoheterastraea pseudocolumellaris* n. sp. *(Plate V, Fig. 2; Plate VI, Fig. 15)*.

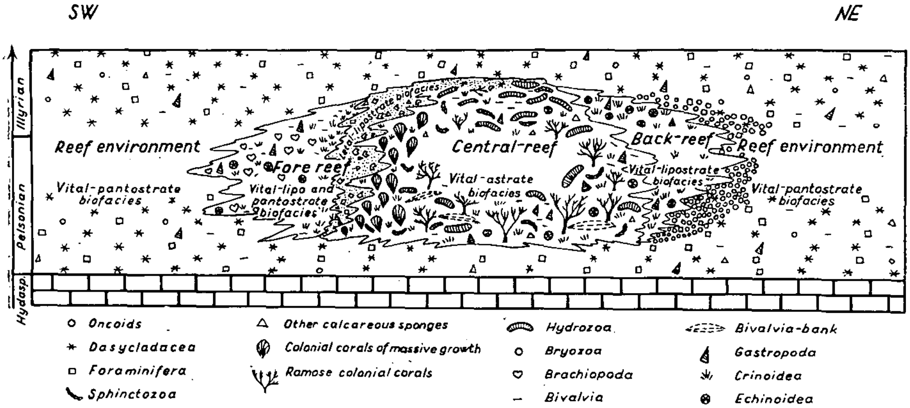

Fig. 3. Original distribution of the biofacies in the investigated area as sketched along the track of Fig. 2.

In the more protected parts of the central reef, beside the hydrozoans, e.g. *Axopora aggtelekensis* n. sp. *(Plate IV, Fig. 4; Plate V, Fig. 1—6)*, the calcareous sponges, e.g. *Colospongia catenulata* OTT *macrocatenulata* n. ssp. *(Plate VI, Fig. 1 and 14)*, *Dictyocoelia manon* MÜNSTER *(Plate VI, Fig. 14)*, *Leiospongia reticularis* MÜNSTER *(Plate VI, Fig. 13)*, *Poronidella* sp. *(Plate VI, Fig. 9)* show an overall distribution.

In the afore-mentioned reef portions (Locality 8) there are 10- to 20-cm-thick lenses constituted by lamellibranchs such as *Daonella moussoni* MERIAN *(Plate VI, Fig. 2, 3, 4)*, *Daonella böckhi* MOJSISOVICS *(Plate VI, Fig. 11)*, *Posidonia* cf. *wengensis* WISSMANN *(Plate VI, Fig. 8)*. Small-sized *Gastropoda* also occur: *Omphaloptychia* sp. *(Plate VI, Fig. 6)*, *Euomphalus* sp. *(Plate VI, Fig. 5)*, and *Worthenia* sp. The crinoids are also frequent: *Entrochus silesiacus* BEYRICH *(Plate VI, Fig. 12)*, *Encrinus* sp. *(Plate VI, Fig. 10)*, *Isocrinus* sp. and *Dadocrinus* sp.

In the northwestern, Középhegy, part of the central-reef some manifestations of shallowing of the water cover of the reef can be observed. Nota bene, the resulting intensification of wave activities must have increased, as it looks, the rate of comminution and have led to a decrease of the coarse components. The organic remnants have become poorer; corals and crinoids can be encountered just sporadically;

however, the representatives of *Dasycladaceae* appear instead. The hydrozoans and sphinctozoans (e.g. *Axopora aggtelekensis* n. sp., Localities 12 and 29) have subsisted.

The central reef is traceable farther east of the road, across the hills Szárhegy and Nagy Jenei-tető up to the Ladinian limestone mass of the Pitits-hegy. In this area the exposures are less satisfactory though, yet all the above phenomena can be observed.

(c) Situated on the SW margin of the reef complex, the *fore-reef* consists of limestones similar, in both colour and detrital texture, to the limestones of the central reef. The only difference is the lack of autochtonous fossils of colony-building organisms. The intraformational limestone debris decreases in grain size with the distance away from the central reef, while the degree of sorting increases in the same direction. This fact testifies to the origin of the debris from the erosion of the central reef.

The oldest part of this facies, adjacent to the echinoderm-and-mollusc beds of the back-reef and immediately overlying the lower horizon of the dasycladaceous limestones, is the brachiopodal limestone belt extending over the crest of the hills Somos-tető and Magos-hegy and seemingly intertonguing along the dip with the central reef. The localities (Nos 17, 18, 19, 20 and 30) falling into this belt contain the following Recoaro-type fauna:

BRACHIOPODA:

Spiriferina avarica BITTNER (Localities 17, 18; *Plate VII, Fig. 10*)
Mentzelia mentzelii DUNKER (Localities 16, 17, 18, 37; *Plate VII, Fig. 4, 5*)
Coenothyris vulgaris SCHLOTHEIM (Localities 16, 17, 18, 37; *Plate VII, Fig. 2b*)
Decurtella decurtata GIRVAN (Localities 17, 18; *Plate VIII, Fig. 7*)
Boeckithyris angustaeformis (BÖCKH) (Localities 19, 20; *Plate VIII, Fig. 4b*)
Tetractinella trigonella (SCHLOTHEIM) (Localities 16, 19, 20, 37; *Plate VIII, Fig. 1a, 1c*)
"Rhynchonella attilina" BITTNER (Localities 19, 20; *Plate VIII, Fig. 5g*).

BIVALVIA:

"Ostrea" sp. (Locality 18; *Plate IX, Fig. 1*).

CRINOID ossicles (Localities 16, 19, 20, 37).

The fore-reef facies on the SW side of the central reef begins with an unsorted intraformational breccia consisting of the mixed detritus of light reef limestones and red crinoidal limestones with a grain size ranging up to the calcirudite fraction *(Plate VII, Fig. 1)*.

Adjacent to the external side of this formation suggestive of the prevalence of wave action is a narrow zone consisting almost totally of crinoid debris *(Fig. 1; Plate VII, Fig. 2)* which is followed, on its turn, by a wider zone rich in brachiopods. This is overlain farther SW by the already-mentioned higher dasycladaceous limestone horizon. The brachipodal limestone has yielded the following fauna:

BRACHIOPODA:

Mentzelia mentzeli DUNKER (Localities 15, 16; *Plate VII, Fig. 3*)
Koeveskallina koeveskalliensis (SUESS) BÖCKH (Locality 15; *Plate VII, Fig. 6*)
Spiriferina avarica BITTNER (Locality 15; *Plate VII, Fig. 7*)
Spiriferina ptychitiphila BITTNER (Locality 15; *Plate VII, Fig. 8*)
Spiriferina fragilis SCHLOTHEIM (Locality 15; *Plate VII, Fig. 9*)
Spiriferina manca BITTNER (Locality 15; *Plate VII, Fig. 11, 12, 13*)
Tetractinella trigonella (SCHLOTHEIM)(Localities 15, 16; *Plate VIII, Fig. 1b, 1d*)
Decurtella decurtata (GIRVAN) (Locality 15; *Plate VIII, Fig. 3a, 3b*)
Coenothyris vulgaris (SCHLOTHEIM) (Localities 15, 16; *Plate VIII, Fig. 2a*)
Boeckithyris angustaeformis (BÖCKH) (Locality 15; *Plate VIII, Fig. 4a, 4b, 4c, 4d, 4e*)
"Rhynchonella" attilina BITTNER (Locality 15; *Plate VIII, Fig. 5a-f, 9*)

Norella cf. *refractifrons* Bittner (Locality 15; *Plate VIII, Fig. 6*)
"Rhynchonella" alteplecta Böckh (Locality 15; *Plate VIII, Fig. 8*)
Aulacothyris angusta (Schlotheim) (Locality 15; *Plate VIII, Fig. 10*).

Bivalvia:

Pecten sp. div. (Locality 15; *Plate IX, Fig. 3, 4*)
Prospondylus sp. (Locality 15; *Plate IX, Fig. 2*)
Mytilus sp. (Locality 15; *Plate IX, Fig. 5*)
Pteria sp. (Locality 15; *Plate IX, Fig. 6*)
Daonella aff. *moussoni* Merian (Locality 15; *Plate IX. Fig. 10*)

Gastropoda:

Stuorella sp. (Locality 15; *Plate IX, Fig. 7, 8*)
Temnotropis sp. (Locality 15; *Plate IX, Fig. 9*).

Echinoidea:

Plate fragments of *Miocidaris* sp. (Locality 15; *Plate IX, Fig. 11*)
Echinus spines (Locality 15; *Plate X, Fig. 1—14*).

Near the reef margin the brachiopod shells occur separated into single valves and the crinoids are also frequent. As one proceeds farther away, one can observe the brachiopod valves to occur unseparated, the crinoids being replaced by echinoids. This suggests the hydrodynamic energy of the environment to have decreased. Unlike the sediments of the central reef, the interstices of the larger grains of the sediment occurring here are not filled by sparry calcite.

3. Age and Significance of the Reef Complex

As testified by the stratigraphic ranges of the fossils met with *(Fig. 4)*, the development of the reef totalling 500 to 600 m in thickness can be supposed to have

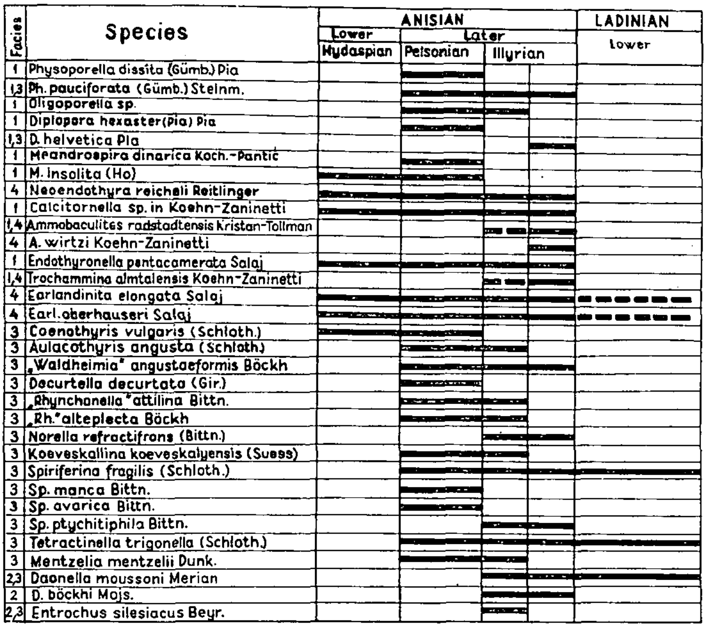

Fig. 4. Distribution within the facies and stratigraphic ranges of biochronologically evaluable species

Facies: *1.* Dasycladaceous limestone surrounding the reef. *2.* Central reef. *3.* Formations of the reef margin. *4.* Dasycladaceous limestone overlying the reef formation.

begun in Early Pelsonian time and to have ended around the Middle Illyrian. In Late Illyrian time the entire area seems to have been covered by dasycladaceous-foraminiferal sediments preceding the *Diplopora annulatissima* Zone (see p. 340).

The Jósvafő-Aggtelek Reef Formation belongs to the open-water, offshore shelf reef facies whose recent counterparts can be met with in the Red Sea [W. SCHÄFER 1967, 1969]. At any rate, the Formation appears to be the oldest of all the Alpinotype Middle Triassic reef deposits described hitherto. According to M. SARTHEIN [1965], H. MILLER [1965] and others, the conclusions as to the occurrence in the Northern Alps of Anisian reef formations can rely merely on the presence of their debris available over a vast area, because no real reef complex has been preserved there.

II. PALEONTOLOGICAL PART

This chapter includes the descriptions of a few new fossil forms found by the author.

Sphinctozoa

Genus: Colospongia LAUBE, sensu OTT 1967

Colospongia catenulata OTT 1967 ssp. *macrocatenulata* nov. ssp.

Plate VI, *Fig. 1 and 14*

HOLOTYPUS: Plate VI, *Fig. 14.*

LOCUS TYPICUS: Locality 8, to the SW of Jósvafő *(Fig. 1).*

STRATUM TYPICUM: Wetterstein reef limestone of Pelsonian age.

DIAGNOSIS: The new subspecies corresponds to the type of the species, but the diametre of the chambers is greater than 6.8, considered to be a limiting value characteristic of the species.

DESCRIPTION: According to E. OTT [1967, p. 31], the genus *Colospongia* is poor in diagnostic features as compared to the other representatives of *Sphinctozoa.* Therefore the discrimination of its species would have to rely on the mode of growth and the size and shape of their chambers. None of the 300 chambers of *C. catenulata* measured by him did exceed 7 mm in diametre. In the Jósvafő material, however, several specimens were found which attain even 9 mm in chamber diametre, their other characteristics being the same as those of OTT's species. Therefore these forms can be regarded just as a larger subspecies of *C. catenulata.*

Hydrozoa

Ordo: Milleporina HICKSON 1901

Familia: Axoporidae BOSCHMA 1951

Genus: Axopora M. EDWARD et J. HAÎME 1850

Axopora aggtelekensis n. sp.

Plate IV, *Fig. 4*; Plate V. *Fig. 3—6*

HOLOTYPUS: Plate V, *Fig. 3, 4.*

LOCUS LYPICUS: Locality 8, SW of Jósvafő *(Fig. 1).*

STRATUM TYPICUM: Pelsonian Wetterstein reef limestone.

DIAGNOSIS: Massive, nodule-like colony with very thin, equal and closely spaced pores penetrating into the spongy coenenchyma. There are only gastropores in each of which a gracious, smooth-faced, spongy gastrostyle can be found.

DESCRIPTION: Flat, massive, nodule-like, of irregular outline, the colonies vary in size, sometimes attaining even 10 to 15 cm in thickness. The surface of the colony is dotted densely with tiny, subcircular gastropores. No dactylopores. The gastropores often attain a length of 10 to 12 mm. Their longitudinal sections are somewhat curved or slightly undulated. In the centre of each pore there is a long, thin gastrostyle. Each gastrostyle has a smooth surface, but the wall of it is of spongy structure. The distance between the boundaries of the gastrostyle and gastropore is 1.5 to 2 times the diametre of the gastrostyle. The colonies used to have a spongy, milleporoid coenenchyma which was destructed during diagenesis. Remnants of coenenchyma, if any, can sometimes be observed in the immediate vicinity of the pores only. The pores had no independent wall, therefore their outline is rather irregular in both transversal and longitudinal sections. No tabulae could be detected, but their absence may be a secondary phenomenon. The gastrostyles were preserved by the fine calcareous ooze that penetrated into them during burial. However, the spongy coenenchyma has been dissolved and replaced by fibrous calcite.

COMPARISON: Thus far only three genera of Eocene-Oligocene age, *Axopora* M. EDWARD et J. HAÎME, *Diamantopora* WEISFERMEL and *Axoporella* BOSCHMA, have been assigned to the *Axoporidae* family. The last two are represented each by the genotype only. The *Axopora* genus, however, includes 9 species.

The diagnostic features of both the species and the genera are rather differently interpreted. According to W. WEISFERMEL [1913], e.g. *Diamantopora* would be characterized by a comparatively thin, compact, shaft-shaped gastrostyle, Axopore, on its turn, by a spongy and considerably wider one. H. BOSCHMA [1951, p. 32], on the contrary, suggests that *Axopora* too had a solid gastrostyle whose thickness varied from species to species. This same author believes *Diamantopora* to be characterized by having more irregularly polygonal gastropore mouths. On the other hand, the pore openings of *Axopora* would be much more circular according to him. This, however, seems to be only the result of the preservation state, as WEISFERMEL put it very clearly [1913, p. 109], that the two specimens on which the genus *Diamantopora* was based were deficient, silicified and impregnated with iron hydroxide.

The genus *Axoporella* described by H. BOSCHMA [1954] was recovered from the Hungarian Eocene. The single species belonging here, *Axoporella kolosváryi,* differs from *Axopora* just by the fine spines ornamenting the surface of the gastrostyle, as the surface of the gastrostyle of both *Axopora* and *Diamantopora* is grooved.

However, there is much uncertainty about the discrimination of the *Axopora* species as well. According to P. M. DUNCAN [1866], the main reason for the difficulties faced in establishing specific features are due to the simplicity of structure. Although H. BOSCHMA [1951, p. 28] emphasizes the divergencies of the species within the genus in respect of the means of colony-building, the structure of coenenchyma, the size of pores and the shape of the gastrostyles, he points out at the same time the variability of what are considered to be specific features.

Nevertheless, with a view to its characteristics, the form under consideration is believed to belong certainly to the genus *Axopora*. Morphologically, it stands closest to *A. michelini* DUNCAN and *A. solanderi* (DEFRANCE). The small and rare tabulae and the longitudinal grooving of the gastrostyles are the only characteristics distinguishing *A. aggtelekensis* from *A. michelini*. Particularly striking is the ressemblance of our species to the variety of *Plate VII, Fig. 2* in P. M. DUNCAN [1866].

Accordingly, the ressemblance of *A. Aggtelekensis* to *A. solanderi* can be taken to be natural, for DOLLFUS [1906] and H. BOSCHMA [1951] consider this last-mentioned form to be identical with *A. michelini.*

By the way, the Aggtelek species is very similar to *Diamantopora lotzi* WEISFERMEL, both in habit and the thinness of the gastrostyles, as well. In addition, as shown by W. WEISFERMEL [1913, p. 110, Plate 14, Fig. 2], *D. lotzi* has only sporadical tabulae.

All in all, on account of the great difference in age as compared to the Lower Tertiary forms, *A. aggtelekensis* should be discriminated specifically.

Anthozoa

Ordo: Scleractinia BOURNE 1900

Subordo: Faviina VAUGHAN et WELLS 1943

Familia: Stilophyllidae VOLZ 1896

Genus: Protoheterastrea WELLS 1937 (pro Hexastraea VOLZ 1896, non SISMONDA 1871)

Protoheterastrea pseudocolumellaris n. sp.

HOLOTYPUS: Plate VI, *Fig. 15.*

LOCUS TYPICUS: Locality 8, SW pf Jósvafő *(Fig. 1).*

STRATUM TYPICUM: Pelsonian Wetterstein reef limestone.

DIAGNOSIS: A *Protoheterastrea* in which, unlike in the case of the two species known hitherto, the septa of the first cycle are intergrown in the centre of the calix giving birth to a pseudocolumella.

DESCRIPTION: Colony markedly ramose. The polyparia, after reaching the point of ramification, describe subparallel curves. 3 to 6 mm in diametre, they are circular or slightly elliptic in crosssection. The theka is thick, its external wall is covered by folds of varying width, there are no longitudinal ribs. Characteristically enough, 6 septa of the first cycle are strikingly well-developed and regular as compared to the subsequent ones. The septa of the second cycle are thinner and shorter; the third cycle is incomplete in most of the cases. Accordingly, the number of the septa is by one lower than in the case of the two St. Cassian species described by W. VOLZ [1896]. The upper edges of the septa are indented, their sides being horizontally grooved. VOLZ's Taschenknospung could also be observed: it is the curving of one of the septa of the first cycle combined with part of the mother calix that has produced the theka of the new individuum. The endotheka is constituted by well-developed tabulae extending from wall to wall.

COMPARISON: The new species differs from the Upper Ladinian *P. fritschi* (VOLZ) and *P. leonhardi* (VOLZ) by the fusion of the first six septa in the centre of the calix. Less frequently, the septa of the first cycle may happen not to be completely intergrown and only one of them extends up to or even beyond the middle of the calix. In the centre of the polyparium a columella-like product can be observed in both cases. As for the rest of the features, however, there is no difference between the three species.

REFERENCES

BALOGH, K. [1948]: Beiträge zur Geologie des südlichen Teiles des im weiteren Sinne genommenen Sziliceer Plateaus. — Annual report Hung. Geol. Inst. 1939—40. *2*, pp. 927—938.

BALOGH, K. [1950]: La stratigraphie du Trias dans le nord de la Hongrie. — Földt. Közlöny. *80*, pp. 231—237.

BALOGH, K. [1961]: Das Mesozoikum Nordungarns. — Annal. Inst. Geol. Publ. Hung., *49*, pp. 365—379.

BALOGH, K. [1964]: Die geologischen Bildungen des Bükk-Gebirges. — Annal. Inst. Geol. Publ. Hung., *48*, 2, pp. 557—719.
BITTNER, A. [1890]: Brachiopoden der alpinen Trias. — Abh. Geol. Reichsanst. Wien *14*, pp. 1—325.
BITTNER, A. [1902]: Brachiopoden und Lamellibranchiaten aus der Trias von Bosnien, Dalmatien und Venetien. — Jahrb. Geol. Reichsanst. Wien *52*, 3—4. pp. 495—642.
BITTNER, A. [1912]: Brachiopoden aus der Trias des Bakonyer Waldes. — Result. Wiss. Erforsch.: Balatonsees. — Palaeontol. d. Umgebung d. Balatonsees *2*, pp. 1—59.
BITTNER, A. [1912]: Lamellibranchiaten aus der Trias des Bakonyer Waldes. — Result. Wiss. Erforsch. Balatonsees. — Palaeontol. Umgebung Balatonsees *2*, pp. 1—106. Wien.
BOSCHMA, H. [1951]: Notes on Hydrocorallia. — Zool. Verh. Mus. Leiden *13*, pp. 1—49.
BOSCHMA, H. [1954]: Die Familie Axoporidae. — Verslag Kon. Ned. Akad. Wetensch. Amsterdam *63*, pp. 1—8.
BOSCHMA, H. [1956]: Milleporina and Stylasterina. — Treatise on Invertebrate Paleontology (ed.: R. C. Moore). F. Coelenterata. — Lawrance, Kansas.
BOSCHMA, H. [1963]: The generic name Axopora. — Proc. Kon. Ned. Akad. Wetensch. Amsterdam *66*, pp. [107—117.
BOSCHMA, H. [1963]: Notes on species of the genus Axopora. — Proc. Kon. Ned. Akad. Wetensch. Amsterdam *66*, pp. 118—129.
BYSTRICKÝ, J. [1955]: Beitrag zur Stratigrapie des Südslowakischen Karstes. — Geol. Práce, Zprávy *3*, pp. 52—57. Bratislava.
BYSTRICKÝ, J. [1957]: Beitrag zur Kenntnis der Diploporen der Gemeriden-Trias. — Geol. Šborník. Bratislava *8*, 2. pp. 239—241.
BYSTRICKÝ, J. [1964]: Stratigrafia a Dasycladaceae mezozoika Slovenského Krasu. — Bratislava, pp. 1—204.
CLOUD, P. N. [1952]: Facies relationships of organic reef. — Bull. Amer. Ass. Petrol. Geol., *36*, *2*, pp. 2115—2150.
DUNCAN, P. M. [1866]: A Monograph of the British Fossil Corals. — Palaeontogr. Soc. London. I.
FLÜGEL, E. [1958]: Die Hydrozoen der Trias. — Neues Jahrbuch. — Geol. Paläont. Abh. Abt. B. Stuttgart *109*, pp. 1—108.
FRECH, F. [1890—91]: Die Korallenfauna der Trias I. — Die Korallen der juvavischen Triasprovinz. — Palaeontographica. Stuttgart *37*, pp. 1—116.
FRECH, F., VOLZ, W. [1896—97]: Die Korallenfauna der Trias II. — Die Korallen der Schichten von St. Cassian in Südtirol. — Palaeontographica *43*, Stuttgart, pp. 1—124.
GAETANI, M. [1966]: Decurtella, nuovo genere triassico di Rhynchonellida. — Trias in Lombardia II. (Studi geologici e paleontologici XVI.) — Riv. Ital. Paleont., *72*, 2, pp. 343—356.
KERKMANN, K. [1966]: Über "Oolithe und Stromatolithe" und die Beteiligung von Algen und der Kalksteinbildung. — Wiss. Zeitschr. Hochsch. Architekt. Bauwesen. Weimar *13*, 3, pp. 293—302.
KERKMANN, K. [1966]: Zur Kenntnis der Riffbildungen in der Werraserie des thüringischen Zechsteins. — Mitt. Geol. Inst. Bergakad. Freiberg *181*, pp. 123—140.
KITTL, E. [1891—94]: Die Gastropoden der Schichten von St. Cassian in der südalpinen Trias. — Annalen Nat. hist. Hofmuseums Wien *6*, 2, pp. 166—262; *7*, 1, pp. 35—97; *9*, 2, pp. 143—277.
KITTL, E. [1912]: Materialien zu einer Monographie der Halobiidae und Monotidae der Trias. — Res. wiss. Erforschung Balatonsees. — Palaeontologie Umgb. Balatonsees *2*, 4, Wien, pp. 1—229.
KITTL, E. [1912]: Trias-Gastropoden des Bakonyer Waldes. Res. wiss. Erforsch. Balatonsees. — Palaeontol. Umgb. Balatonsees *2*, 5, Wien, pp. 1—54.
LOGAN, B. W., REZAK, R., GINSBURG, R. N. [1964]: Classification and environmental significance of algal Stromatolithes. — Journ. Geol., *72*, Chicago, pp. 68—83.
KRISTAN-TOLLMANN, E., TOLLMANN, A. [1967]: Crinoiden aus dem zentralalpinen Anis (Leithagebirge, Thörler Zug und Radstädter Tauern). — Wiss. Arbeit. Burgenland *36*, Eisenstadt, pp. 1—33.
MILLER, H. [1965]: Die Mitteltrias der Miemiger Berge mit Vergleichen zum westlichen Wettersteingebirge. — Verhandl. Geol. Bundesanst., Wien, pp. 187—212.
OTT, E. [1967]: Segmentierte Kalkschwämme (Sphinctozoa) aus der alpinen Mitteltrias und ihre Bedeutung als Riffbildner im Wettersteinkalk. — Abh. Bayer. Akad. Wiss. Math.-nat. w. Kl. München, N. F. *131*, pp. 5—96.
PIA, J. [1940]: Wirtelalgen (Dasycladaceen) aus den anisischen Kalken des Szilicei fennsik in Nordungarn. — Abh. min.-geol. Inst. Tisza-Univers., Debrecen, *18*, (Sonderdr. aus Tisia *4*) pp. 1—7.
PIA, J. [1942]: Übersicht über die fossilen Kalkalgen und die geologische Ergebnisse ihrer Untersuchung. — Mitt. Alpenländ. Geol. Verein. (Mitt. Geol. Ges. Wien) 33. pp. 11—34.

SARNTHEIN, M. [1965]: Sedimentologische Profilreihen aus den mitteltriadischen Karbonatgesteinen der Kalkalpen nördlich und südlich von Innsbruck. — Verhandl. Geol. Bundesanstalt Wien, *1—2*, pp. 119—162.

SCHÄFER, W. [1967]: Biofazies-Bereiche im subfossilen Korallenriff Sorso (Rotes Meer). — Senckenbergiana Lethea *48*, pp. 107—133.

SCHÄFER, W. [1969]: Sorso, Modell der Biofazies-Sequenzen im Korallenriff-Bereich des Schelfs. — Senckenbergiana Maritima (I) *50*, pp. 165—188.

SCHRÉTER, Z. [1935]: Die geologischen Verhältnisse der Umgebung von Aggtelek. — Relat. Annuae Inst. Geol. Publ. Hung. 1925—28. pp. 145—155.

SICKENBERG, O. [1932]: Eine rhätische Korallenriff aus der Osterhorngruppe. — Verh. Zool. Botan. Ges. Wien, *82*, pp. 35—40.

SIEBER, R. [1933]: Paläobiologische Untersuchungen an der Fauna der Rötewand Riffmasse in der nördlichen Osterhorngruppe. Anzeig. Österr. Akad. Wiss. Math.-nat. w. Kl. Wien, *19*, 1—3, pp. 238—240.

VINASSA DE REGNY, P. [1912]: Trias-Spongien aus dem Bakony. Res. wiss. Erforsch. Balatonsees. — Palaeont. Umgb. Balatonsees *1*, 2, Wien, pp. 1—22.

VINASSA DE REGNY, P. [1912]: Neue Schwämme, Tabulaten und Hydrozoen aus dem Bakony. — Res. wiss. Erforsch. Balatonsees. — Palaeont. Umgb. Balatonsees *1*, 3, pp. 1—17.

VINASSA DE REGNY, P. [1912]: Trias-Tabulaten, Bryozoen und Hydrozoen aus dem Bakony. — Res. wiss. Erforsch. Balatonsees. — Palaeont. Umgb. Balatonsees *1*, *4*, pp. 1—22.

VOGEL, K. [1963]: Riff, Bioherm, Biostrom. — Neues Jahrb. Geol. Pal. Monatsh., Stuttgart, *12*, pp. 680—688.

WEISFERMEL, W. [1913]: Tabulaten und Hydrozoen. — In: Böhm, J.—Weisfermel, W.: Über tertiäre Versteinerungen von den Bogenfelser Diamantfeldern. — Beitr. geol. Erforsch. Deutsch. Schutzgeb., Berlin, *5*, pp. 83—111.

ZANKL, H. [1969]: Der hohe Göll. Aufbau und Lebensbild eines Dachsteinkalk-Riffes in der Obertrias der Nördlichen Kalkalpen. — Abh. Senckenberg. Nat. f. Ges. *519*, pp. 1—96.

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DR. GÁBOR SCHOLZ
Hungarian State Geological Institute
Népstadion út 14, Budapest XIV.
Hungary

PLATES I — XI

PLATE I

Fossils from the sediments of the reef environment

1. Meandrospira dinarica KOCH.-DEV. et PANTIĆ (× 100).
2. Meandrospira insolita (HO), *Endothyra* sp. (× 80).
3. Meandrospira dinarica KOCH.-DEV. et PANTIĆ (× 100).
4. Neoendothyra reicheli REITLINGER (× 70).
5. Calcitornella sp. (in KOEHN-ZANINETTI) (× 100).
6. Endothyronella cf. *pentacamerata* SALAJ (× 100).
7. Trochammina almtalensis KOEHN-ZANINETTI (× 100).
8. Ammobaculites wirtzi KOEHN-ZANINETTI (× 75).

The specimens *1, 2, 3, 5* and *6* derive from Locality 1, specimens *4, 7* and *8* from Locality 3 (see *Fig. 1*).

PLATE II

Fossils from the sediments of the reef environment.

1. Physoporella dissita (GÜMBEL) (× 13).
2. Physoporella pauciforata (GÜMBEL) (× 13).

3. *Diplopora hexaster* PIA (× 12.5).
4. *Diplopora hexaster* (PIA) (× 12.5).
5. *Oligoporella* sp. (× 13).

Specimen *1* derives from Locality 1, the rest from Locality 2 *(Fig. 1)*.

PLATE III

The onkolite zone

1. Man-tall limestone block with "bedded" onkoids.
2. Small onkoids distributed in "non-bedded" pattern from the limestones of the basal horizon of the formation (× 10).
3. Large, regular onkoid which has overgrown a *Meandrospira* (× 10).
4. Onkoids (× 10).

Specimens *1* and *3* derive from Locality 5, specimen *2* from Locality 6, specimen *4* from Locality 7 of *Fig. 1*.

PLATE IV

Fossils from the sediments of the central reef

1. Bush-like colony of gracious, ramose corals (× 1.2).
2. Large massive colony of "*Thecosmilia*" sp. from the braker region of the reef complex. Natural size.
3. *Pinacophyllum* cf. *parallelum* FRECH from the braker region. 2/3 of the original size.
4. *Axopora aggtelekensis* n. sp. Thin section parallel to the surface of the colony (× 15).

Specimens *1* and *4* derive from Locality 8, specimen *2* from Locality 9, specimen *3* from Locality 11 of *Fig. 1*.

PLATE V

Fossils from the sediments of the central reef

1. *Axopora aggtelekensis* n. sp. Surface of the colony (× 1.3).
2. *Protoheterastraea pseudocolumellaris* n. sp. Natural size. Paratypoid.
3. *Axopora aggtelekensis* n. sp. Polished section. Holotype (× 1.3).
4. Idem. Polished section parallel to the surface of the colony (× 1.3).
5. *Axopora aggtelekensis* n. sp. Thin section perpendicular to the surface of the colony (×15).
6. One of the gastropores of specimen *5*, with a gastrostyle in the centre (×50).

All specimens derive from Locality 8 (above the Vörös-tó) of *Fig. 1*.

PLATE VI

Fossils from the sediments of the central reef

1. *Colospongia catenulata* OTT ssp. *macrocatenulata* nov. ssp. (×1.7).
2., 3., 4. *Daonella moussoni* MERIAN (×1.8).
5. cf. *Schizostoma* sp. (×2).
6. *Omphaloptychia* sp. (×3).
7. Skeletal elements of crinoids (×1.2).
8. *Posidonia* cf. *wengensis* WISSMANN (×2).
9. *Poronidella* sp. (×2).
10. Ossicles of *Encrinus*. Natural size.
11. *Daonella böckhi* MOJSISOVICS (×1.5).

12. Entrochus silesiacus BEYRICH (×1.2).
13. Corroded surface of reef limestone with specimens of *Leiospongia reticularis* MÜNSTER (×1.2).
14. Colospongia catenulata OTT ssp. *macrocatenulata* nov. ssp. and *Dictyocoelia manon* MÜNSTER (x1.8).
15. Protoheterastrea pseudocolumellaris n. sp. Holotype, longitudinal section. Natural size.

All specimens derive from the locality above the Vörös-tó (*Fig. 1*, Locality 8).

PLATE VII

Rocks and fossils from the fore-reef sediments

1. Intraformational breccia from Locality 13 of Fig. 1.
2. Massive crinoid remnants from Locality 14 of Fig. 1.
3. Mentzelia mentzelii DUNKER (1.1x). Locality 15.
4. Idem (×1.3). (Localities 17—18).
5. Idem (×1.3). (Localities 17—18).
6. Koeveskallina koeveskalyensis (SUESS) (×2). Locality 15.
7. Spiriferina avarica BITTNER (×2.1). Locality 15.
8. Spiriferina ptychitiphila BITTNER (×1.2). Locality 15.
9. Spiriferina fragilis (SCHLOTHEIM) (×2). Locality 15.
10. Spiriferina avarica BITTNER (×2.4). (Localities 17—18).
11., 12., 13. Spiriferina manca BITTNER (×2.2). Locality 15.

PLATE VIII

Fossils from the fore-reef sediments

1. a—d. Tetractinella trigonella (SCHLOTHEIM). Natural size.
2. a—b. Coenothyris vulgaris (SCHLOTHEIM) (×1.2).
3. a—b. Decurtella decurtata (GIR.) (×3). (Locality 15).
4. a—e. Boeckithyris angustaeformis BÖCKH (×1.3).
5. a—g. "Rhynchonella" attilina BITTNER (×1.6).
6. Norella cf. refractifrons BITTNER (×2.6).
7. Decurtella decurtata (GIR.) (×3). (Magashegy).
8. "Rhynchonella" alteplecta BÖCKH (×3).
9. "Rhynchonella" attilina BITTNER (×1.6) (Locality 15.).
10. Aulacothyris angusta (SCHLOTHEIM) (×2).

Specimens *1a, 4b* and *5g* derive from the Somostető (Loc. 19, 20), specimens *1c, 2b* and *8* from the Magas-hegy (Loc. 17, 18), the rest from the dolina near the Béke-cave (Locality 15).

PLATE IX

Fossils from the fore-reef sediments.

1. Ostrea sp. (×2). (Magashegy, Locality 18).
2. Prospondylus sp. (×2). (Locality 15).
3. Pecten sp. (×3). (Locality 15).
4. Pecten sp. (×4). (Locality 15).
5. Mytilus sp. (×1.6). (Locality 15).
6. Pteria sp. (×6). (Locality 15).
7., 8. Stuorella sp. (×6). (Locality 15).
9. Temnotropis sp. (×6). (Locality 15).
10. Daonella cf. *moussoni* MERIAN (×2). (Locality 15).
11. Miocidaris sp. Fragment of plate (×5). (Locality 15).

Specimen *1* derives from the Magas-hegy, the rest derive from the dolina near the Béke-cave.

PLATE X

Fossils from the fore-reef sediments.

1. Echinoid spine, indented on both sides (× 2.5).
2. and *3.* Idem (×2.7).
4. Flattened echinoid spine (×3).
5. Echinoid spine ("piquant") (× 2).
6. Lanceolate echinoid spine (× 2).
7. *Isocrinus* sp. Ossicles (× 2.2).
8. Spine of an echinoid carrying acute spines on both sides (×1.2).
9. and *10.* *Miocidaris* sp. Fragment of plate (× 5).
11. Echinoid spine of bullet shape (× 2).
12. *Tetractinella trigonella* (SCHLOTH.) and ossicle of *Encrinus* sp. (×1.5).
13. Festooned echinoid spine (× 3).
14. Ossicles of *Encrinus* sp. (× 1.3).

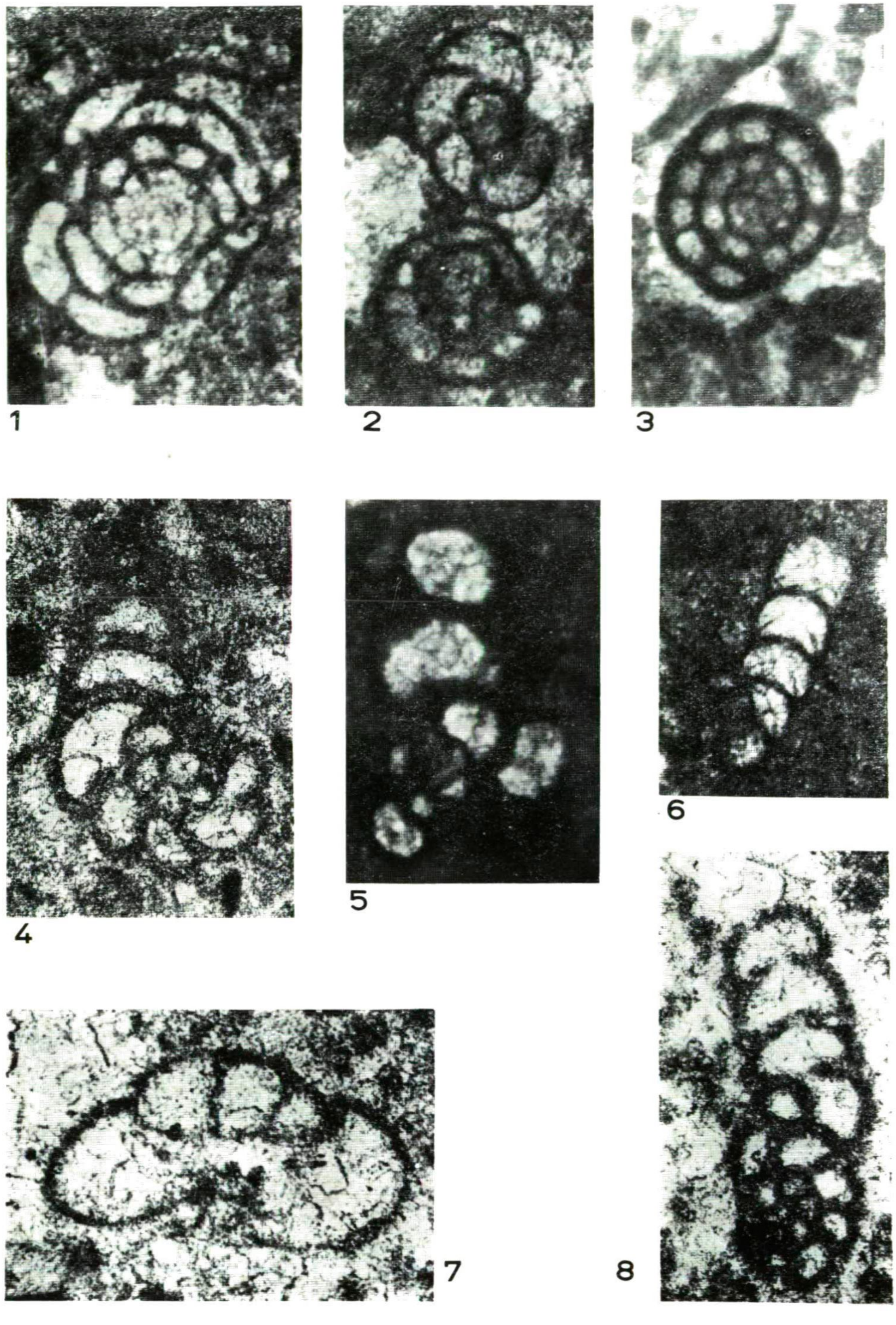
All fossils derive from the doline near the Béke-cave (Locality 15 of the geological map of *Fig. 1*).

PLATE XI

Thin sections from the sediments of the reef complex

1. Cavernous reef limestone with fibrous, void-filling calcite. Central reef, Vörös-tó. (× 10).
2. Thin section of a typical reef limestone similar to the former. Central reef, entrance to Béke-cave (× 10).
3. Bioclastic, compact sediment of the fore-reef. Locality near the Béke-cave (× 10).
4. Cross section of a brachiopod shell figuring as a sedimentary trap and of an echinoid spine in the limestone of the fore-reef. Locality near the Béke-cave (× 10).

Sample *1* derives from Locality 8, sample *2* from Locality 21, samples *3* and *4* from Locality 15 of *Fig. 1*.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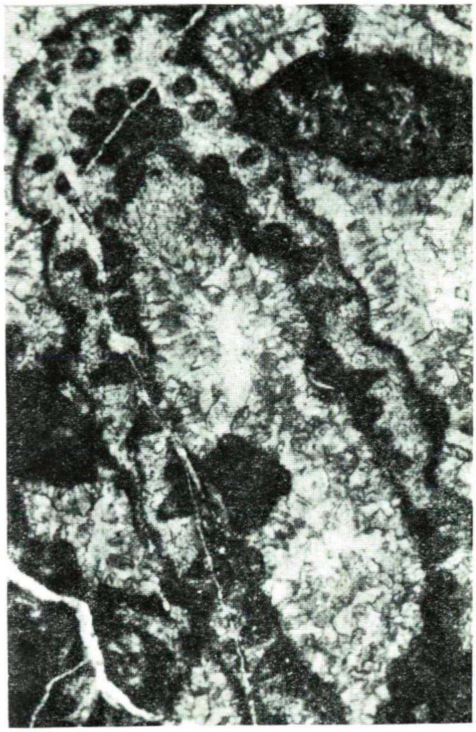

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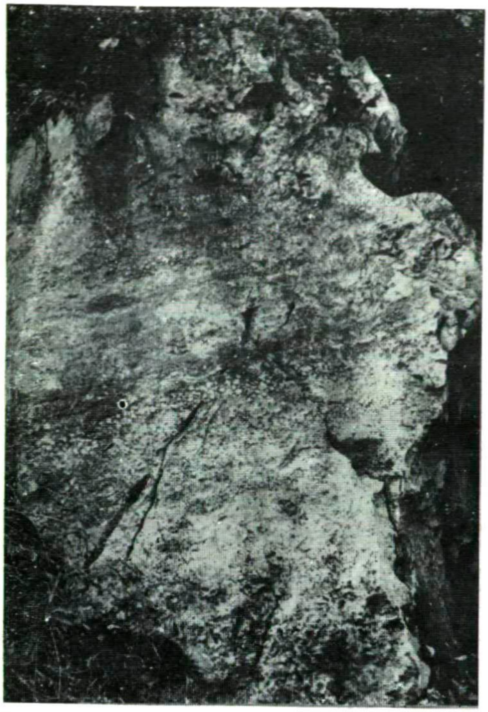

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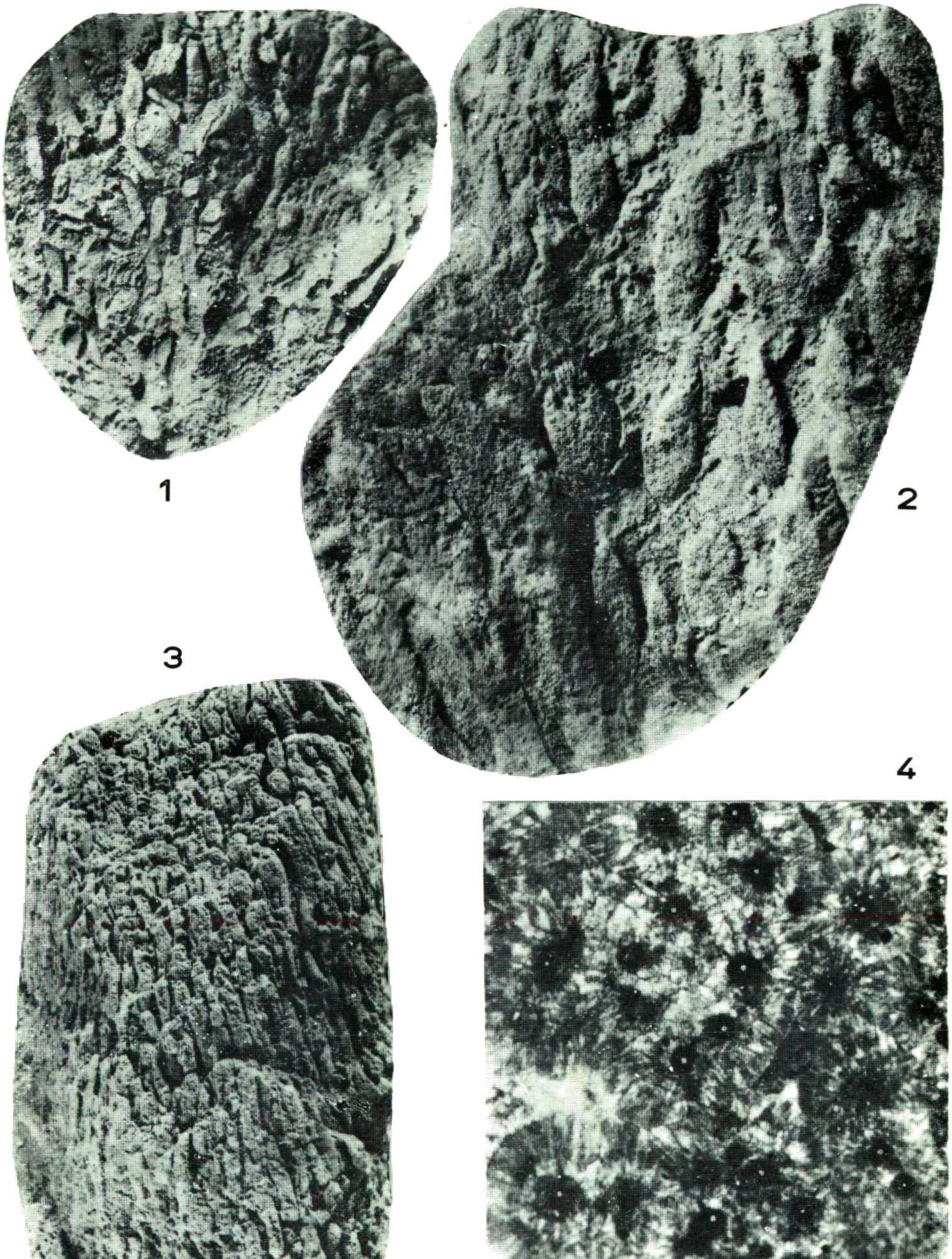
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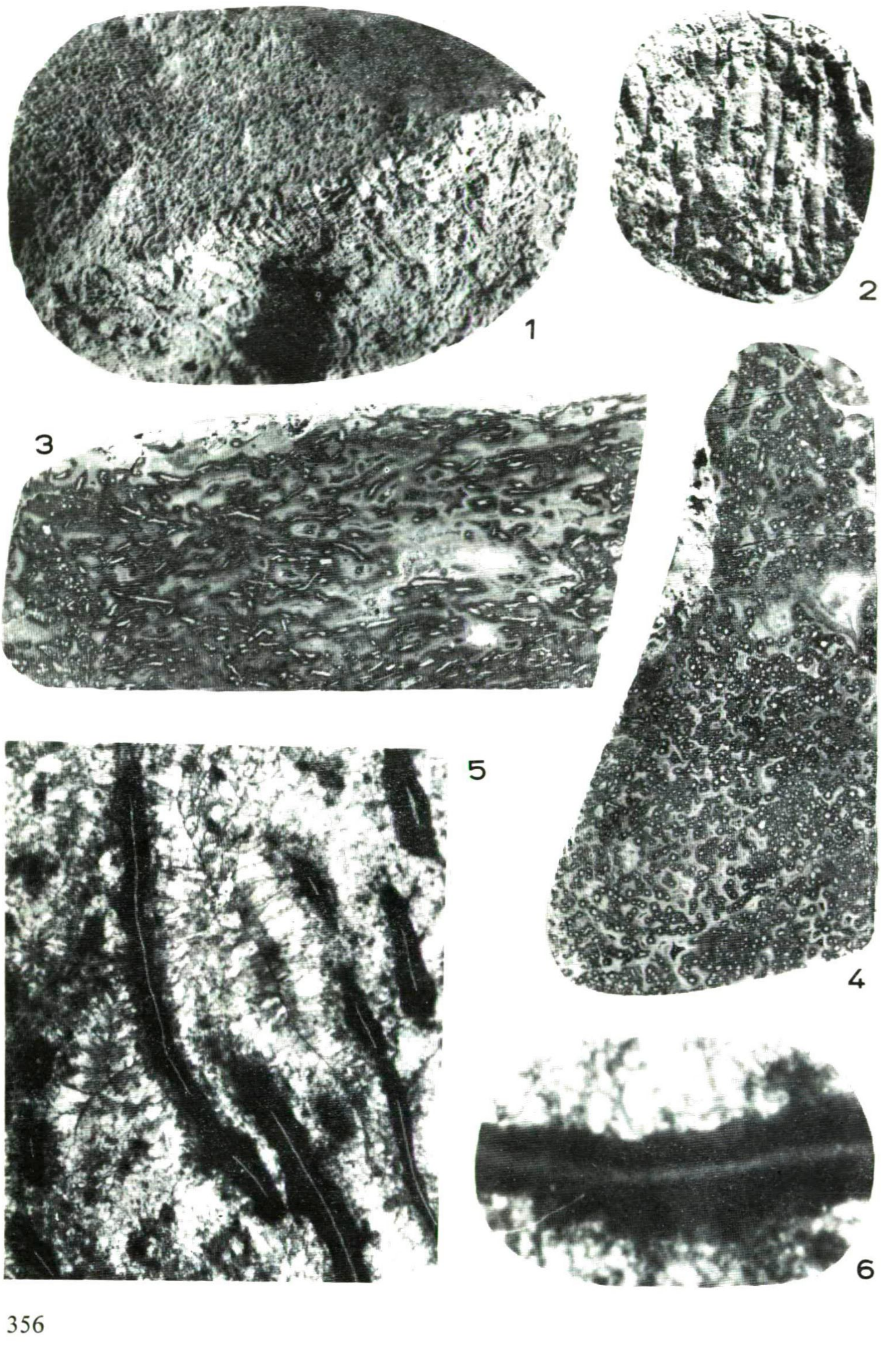
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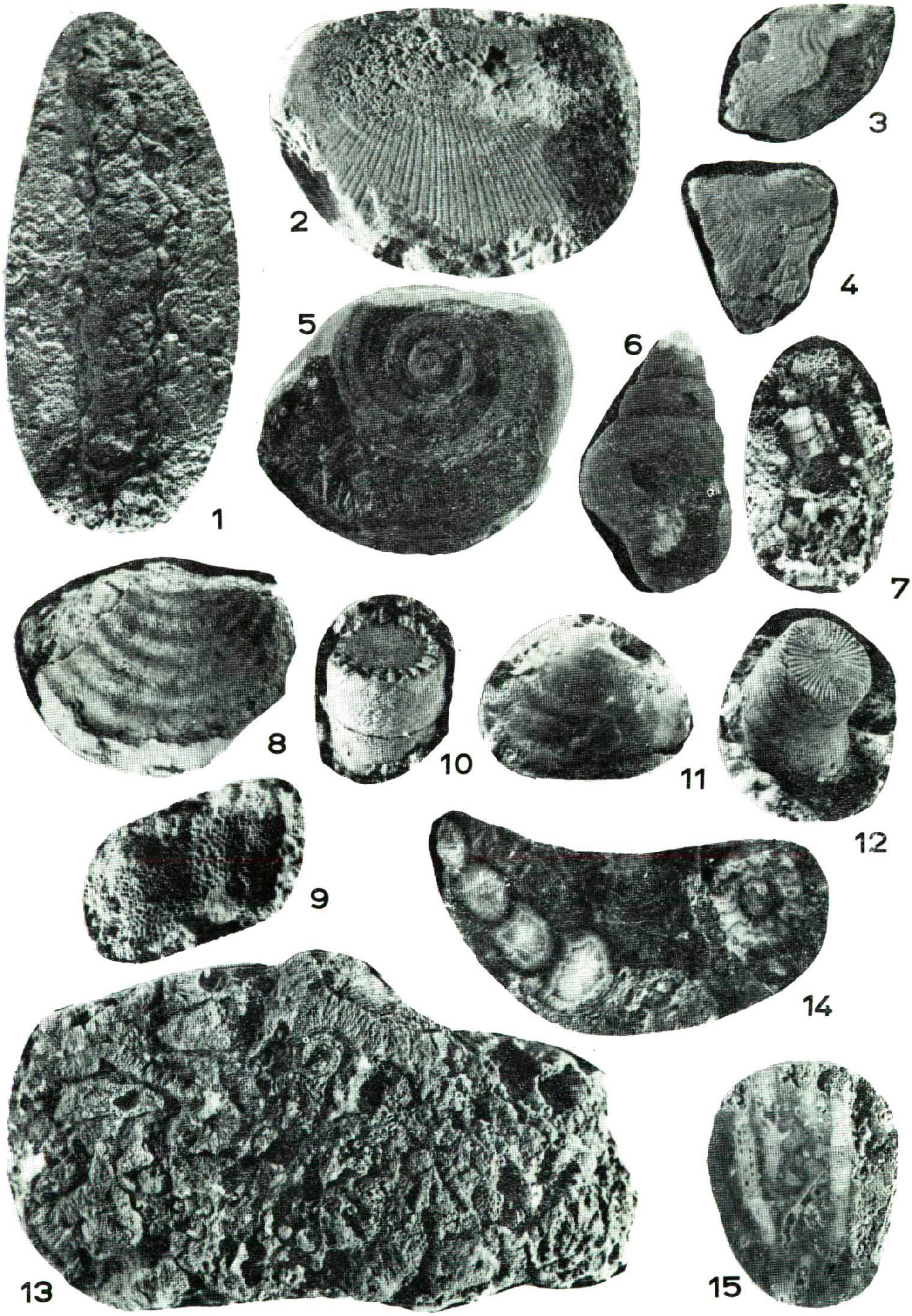
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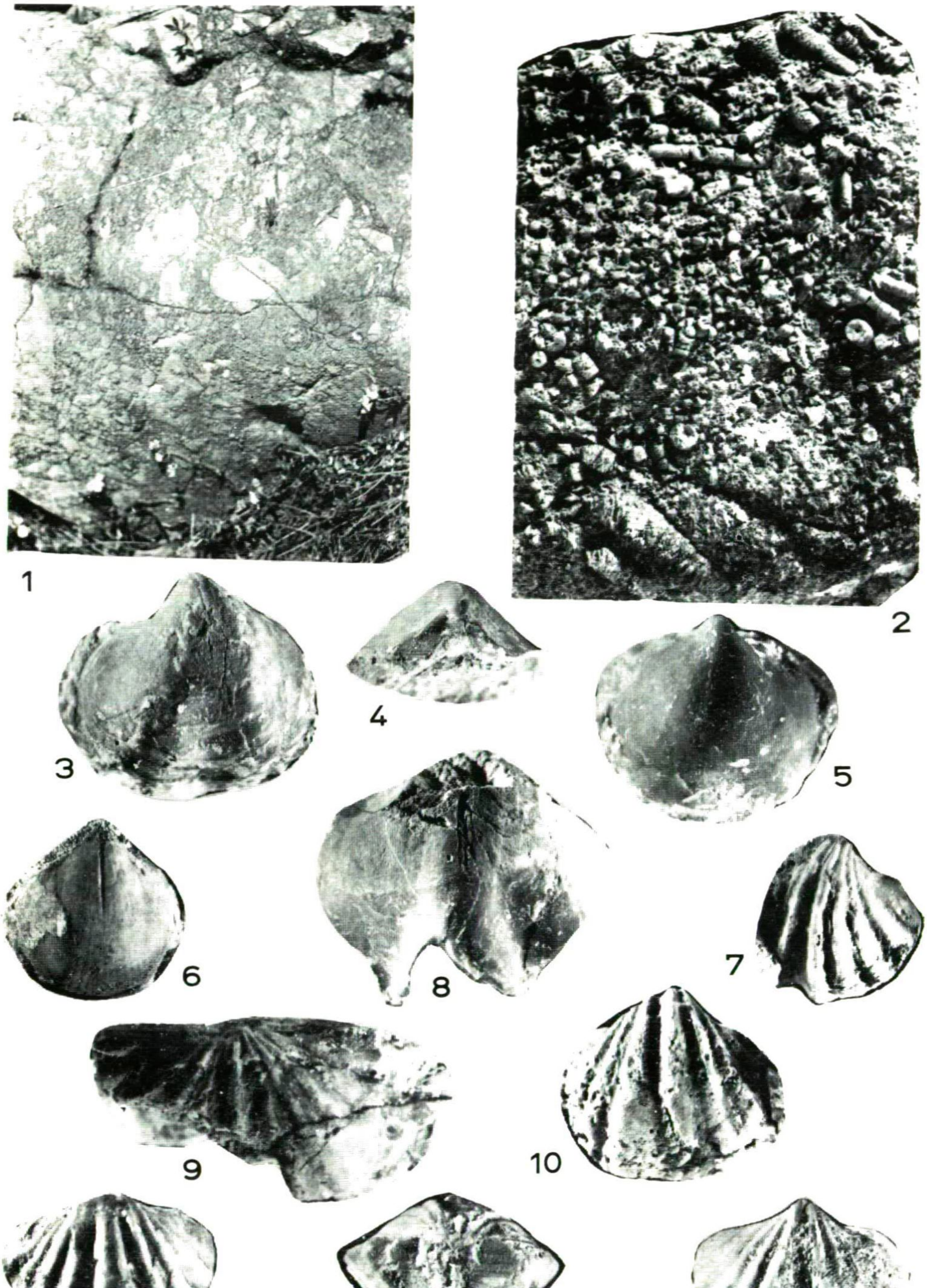
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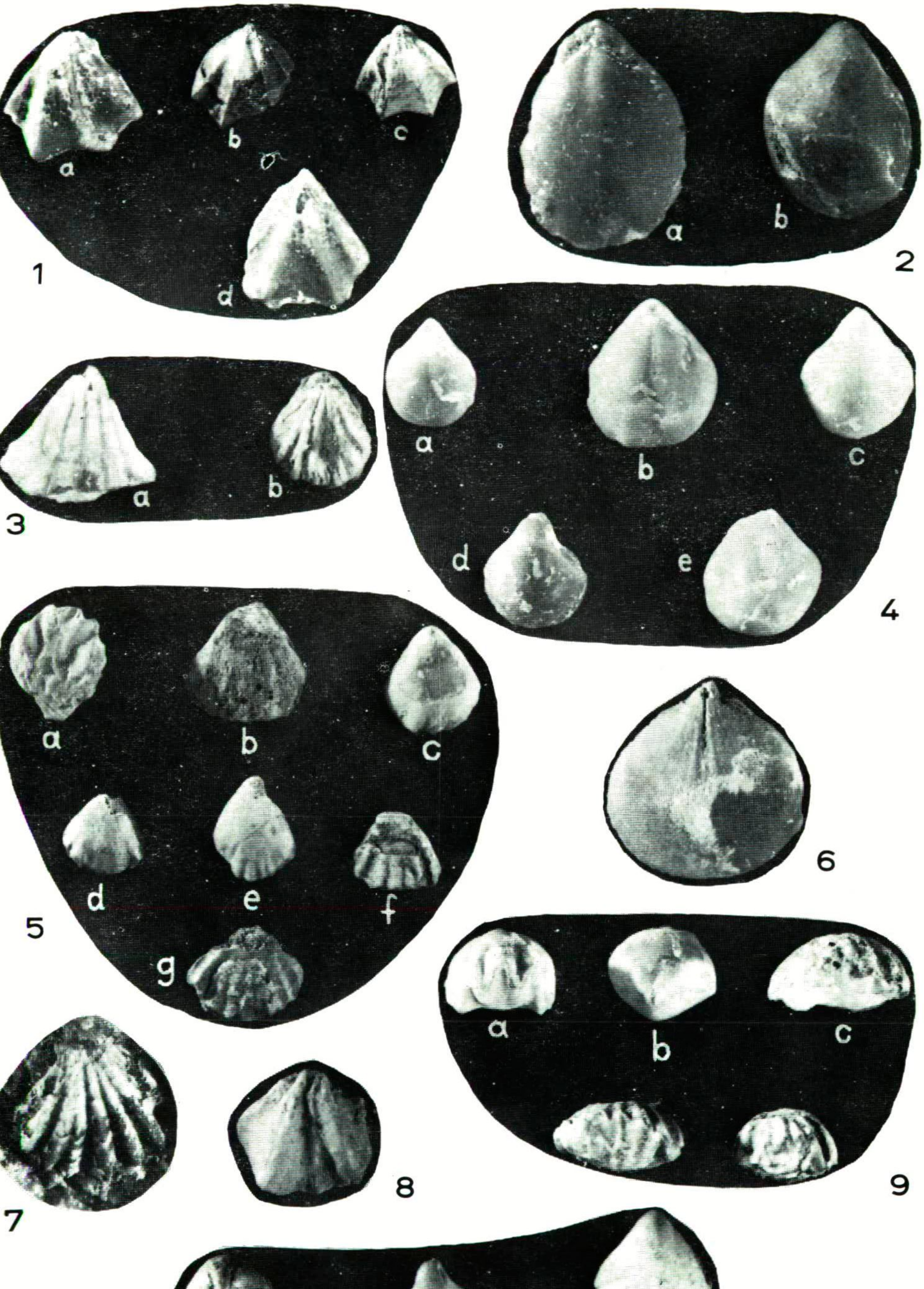
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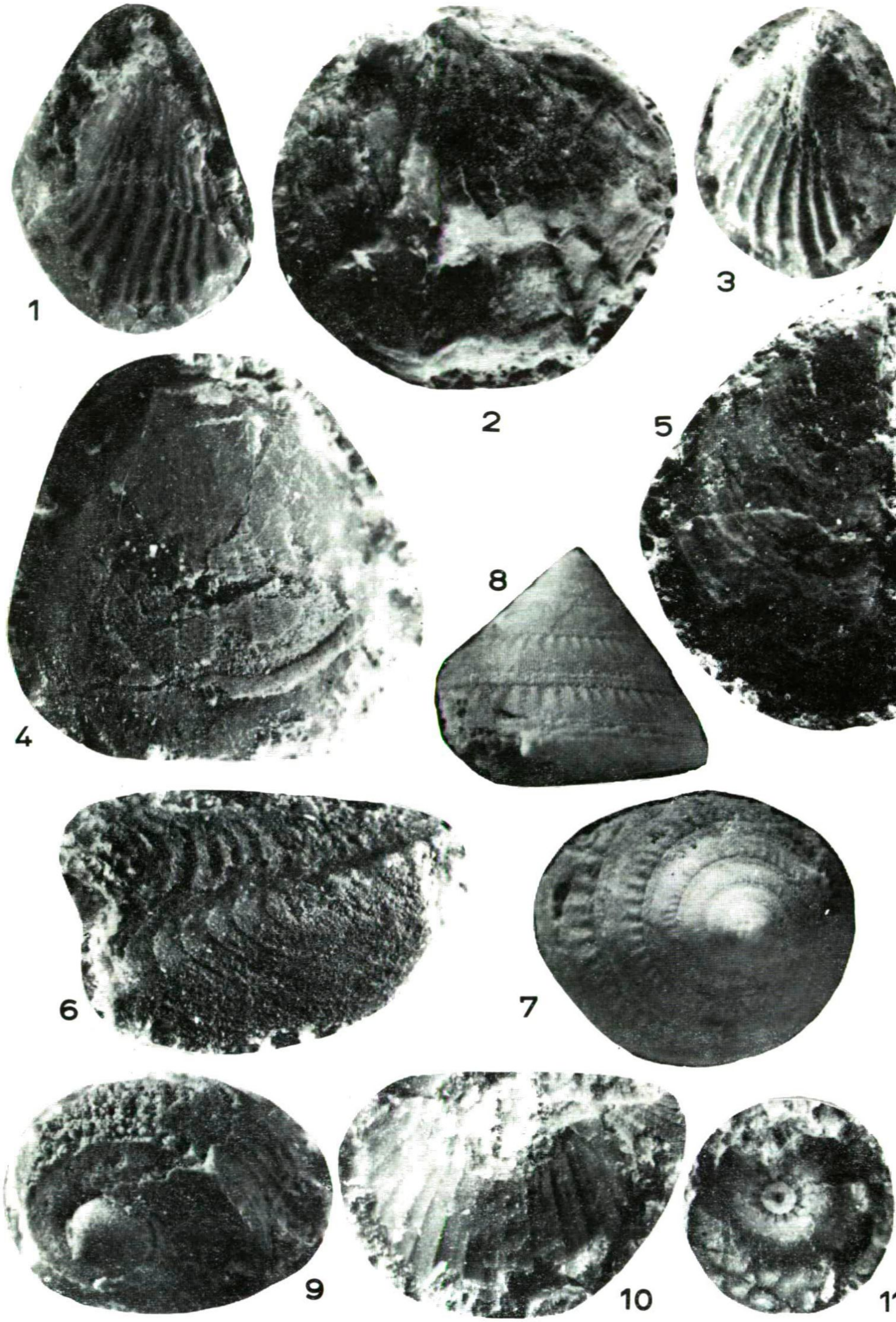
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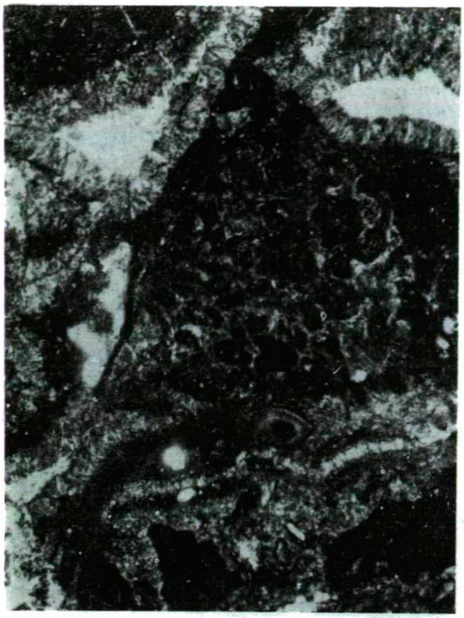

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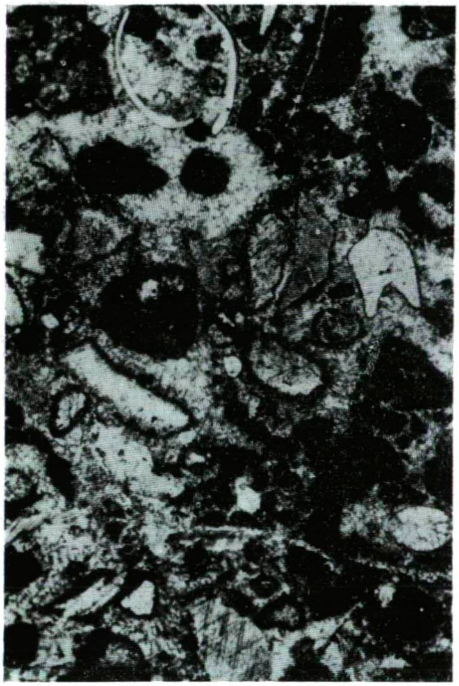

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